AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (original) Apparatus for determining positional information relating to an object, comprising:-

means for receiving, comprising a plurality of receiving elements;

detection means for detecting signals received at the receiving elements and for generating output signals representative of the received signals; and

processing means operable to apply, for each receiving element, a process to the output signal generated from the signal received at that receiving element separately from any output signal generated from a signal received at any other receiving element, so as to obtain a respective value of a parameter representative of the signal received at that receiving element, the processing means being further operable to compare the values of the parameter thus obtained so as to obtain positional information relating to the object.

2. (original) Apparatus according to Claim 1, wherein the parameter is one of phase and time.

3. (currently amended) Apparatus according to Claim 1 ~~or 2~~, wherein the process to be applied by the processing means is dependent upon a characteristic, or an expected characteristic, of the signals.

4. (original) Apparatus according to Claim 3, wherein the characteristic, or expected characteristic, is at least one of frequency, phase, bandwidth, and pulse width.

5. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, wherein the process to be applied by the processing means is dependent upon a characteristic, or expected characteristic, of the object, and preferably is dependent upon the distance, or the expected distance, of the object from the receiving means.

6. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, further comprising selecting means adapted to select the process to be applied by the processing means from a plurality of possible processes.

7. (original) Apparatus according to Claim 6, wherein:-
the apparatus comprises means for storing a plurality of sets of process data;
and the selecting means is adapted to select one set of process data from the plurality of sets of process data, thereby to select the process to be applied by the processing means.

8. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, further comprising means for changing the process to be applied by the processing means in

dependence upon at least one previously obtained value of the parameterand/or in dependence upon previously obtained positional information relating to the object.

9. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, wherein the process comprises a matched filter.

10. (original) Apparatus according to Claim 9, wherein the process comprises applying a filter to the output signal at a plurality of different time offsets and selecting a time offset in dependence upon the outputs from the filter.

11. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, wherein the operation of the processing means comprises application of a matched filter to detect the interval between signals received by a plurality of the receiving elements, whereby to determine an angular position of the object.

12. (currently amended) Apparatus according to ~~any of Claims 9 to 11~~ Claim 9, comprising means for generating the matched filter in dependence upon the shape of the at least one time varying signal, and preferably in dependence upon the shape of the envelope of the at least one time varying signal.

13. (original) Apparatus according to Claim 12, wherein the generating means is adapted to fit the shape of the at least one time varying signal, or the envelope of the at least one time varying signal to a function, preferably to a quadratic function.

14. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, wherein the receiving and detecting means are adapted to receive and detect a signal having a bandwidth greater than 5%, 10% or 20% of its frequency.

15. (currently amended) Apparatus according to ~~any preceding claim~~ Claim1, wherein each signal has a characteristic frequency of between 0.5GHz and 24 GHz, preferably between 2GHz and 12GHz, and more preferably between 5.8GHz and 7.2GHz.

16. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, wherein the signals are pulsed signals.

17. (original) Apparatus according to Claim 16, wherein each pulsed signal comprises at least five cycles, and preferably comprises at least 10, 20, 50, 100 or 500 cycles.

18. (currently amended) Apparatus according to Claim 16 ~~or 17~~, wherein each pulsed signal has a pulse length of greater than 2ns, preferably greater than at least one of 5ns, 10ns, 20ns, and 50ns.

19. (currently amended) Apparatus according to ~~any of Claims 16 to 18~~ Claim 16, wherein the signals comprise a pulse train having a characteristic repetition frequency of between 2MHz and 20 MHz, possibly between 5MHz and 15 MHz, and possibly between 10.5MHz and 13.5MHz.

20. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, wherein the positional information is an angular position of the object.

21. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, further comprising means for transmitting a probe signal towards the object, and wherein the means for receiving is adapted to receive a reflection of the probe signal from the object.

22. (original) Apparatus according to Claim 21, wherein the means for transmitting a probe signal is adapted to transmit a different signal to the signal transmitted by a transmitter associated with the object.

23. (currently amended) Apparatus according to Claim 21 ~~or 22~~, further comprising means for encoding the probe signal, whereby it can be distinguished from the signal received from the object.

24. (currently amended) Apparatus according to ~~any of Claims 21 to 23~~ Claim 21, further comprising means for determining the positional information of an object irradiated by the probe signal.

25. (original) Apparatus according to Claim 24, further comprising means for comparing the positional information of the irradiated object to positional information relating to at least one known object, whereby anomalous objects can be identified.

26. (original) Apparatus according to Claim 25, further comprising means for generating an alert signal in dependence on the result of the comparison.

27. (currently amended) Apparatus according to Claim 25 ~~or 26~~, wherein the or each object includes or comprises an object incorporating a transmitter.

28. (currently amended) Apparatus according to ~~any preceding claim~~ Claim 1, wherein the signals are signals transmitted by a transmitter associated with the object.

29. (original) Apparatus according to Claim 28, wherein the signals transmitted by the transmitter associated with the object are Ultra Wide Band (UWB) signals.

30. (original) Method of determining positional information relating to an object, comprising:-

receiving signals at a plurality of receiving elements;

detecting signals received at the receiving elements and for generating output signals representative of the received signals; and

processing, for each receiving element, the output signal generated from the signal received at that receiving element separately from any output signal generated from a signal received at any other receiving element, so as to obtain a respective value of a values of the parameter thus obtained so as to obtain positional information relating to the object.

31. (original) Apparatus for determining positional information relating to an object incorporating a transmitter, the apparatus comprising:

means for receiving a signal pulse transmitted by the incorporated transmitter, said means for receiving being arranged in a single housing or on a common substrate, and said signal pulse being an ultra-wide band signal pulse; and

detecting means, coupled to the receiving means, for producing an output from which the angular position of the object can be determined;

wherein the means for receiving comprises a plurality of receiving elements, and the detecting means is adapted to detect the relative timing of the signal pulse as received at the plurality of receiving elements, whereby the angular position can be determined.

32. (original) Apparatus according to Claim 31, wherein the signal pulse is transmitted at a particular pulse repetition frequency, and the apparatus comprises tuning means to receive pulses of that frequency.

33. (original) Apparatus according to Claim 32 wherein the frequency comprises multiple frequencies, having a particular frequency separation.

34. (currently amended) Apparatus according to ~~any of claims 31 to 33~~ Claim 31, further comprising means for triggering the detecting means, wherein the triggering means is independent of the generation of the transmitted signal.

35. (original) Apparatus according to Claim 34, further comprising means for receiving triggering control signals, and wherein the triggering means is adapted to trigger the detecting means in dependence on the received triggering control signals.

36. (original) Apparatus according to Claim 35, wherein the triggering means is adapted to trigger the detecting means at a frequency determined by the control signals.

37. (currently amended) Apparatus according to ~~any of Claims 34 to 36~~ Claim 34, wherein the transmitted signal has a characteristic repetition frequency and the triggering means is adapted to trigger the detecting means at a triggering frequency different to the characteristic repetition frequency.

38. (original) Apparatus according to Claim 37, wherein the triggering frequency F_{trig} is determined by $(F_{cr}/n) + F_{diff}$, where F_{cr} is the characteristic repetition frequency, n is an integer frequency divider ratio, and F_{diff} is a scan rate.

39. (original) Apparatus according to Claim 38, wherein n is greater than 1, and preferably greater than 2, 3, 4 or 5.

40. (currently amended) Apparatus according to Claim 38 ~~or 39~~, wherein F_{diff} is non-zero, and preferably less than 5%, 2% or 1% of the magnitude of F_{cr}, and more preferably less than 0.5% of the magnitude of F_{cr}.

41. (currently amended) Apparatus according to ~~any of claims 31 to 40~~ Claim 31, wherein the plurality of receiving elements are arranged in a substantially planar configuration.

42. (currently amended) Apparatus according to ~~any of claims 31 to 41~~ Claim 31, wherein the means for receiving is arranged in a single housing or on a common substrate.

43. (currently amended) Apparatus according to ~~any of claims 31 to 42~~ Claim 31, further comprising a communications interface for communicating with a processing means.

44. (original) Apparatus according to Claim 43, wherein the communications interface is adapted to output a plurality of signals representative of signals received at the apparatus.

45. (currently amended) Apparatus according to Claim 43 ~~or 44~~, wherein the communicating means is adapted to receive control signals from the processing means.

46. (currently amended) Apparatus according to ~~any of claims 31 to 45~~ Claim 31, further comprising processing means for processing the output of the detection means to determine positional information relating to the object.

47. (original) Apparatus according to Claim 46, wherein the processing means is adapted to process the output of the detection means in conjunction with a further angular position so as to determine the displacement of the transmitter associated with the object.

48.(currently amended) Apparatus according to Claim 46 ~~or 47~~, wherein the processing means is adapted to process the output from the detection means to determine the angular position of the object.

49. (original) Apparatus according to Claim 48, wherein the processing means is adapted to compute timing differentials between a plurality of signals received from the detection means, and to determine the angular position in dependence on the timing differentials between at least two of the plurality of signals.

50. (currently amended) Apparatus according to ~~any of Claims 46 to 49~~ Claim 46, wherein the processing means is adapted to process the output from the detection means to determine the pseudorange of the object.

51. (original) Apparatus according to Claim 50, wherein the processing means is adapted to process the output from the detection means to determine the amplitude of a received signal, and to determine the pseudorange in dependence on the amplitude.

52. (currently amended) Apparatus according to ~~any of Claims 31 to 51~~ Claim 31, further comprising means for outputting a signal representative of the displacement of the object.

53. (currently amended) Apparatus according to ~~any of claims 31 to 52~~ Claim 31, wherein the receiving means is adapted to receive a pulse train having a characteristic pulse frequency, and the detecting means is adapted to output a signal representative of the received pulse train.

54. (original) Apparatus according to Claim 53, wherein the detecting means is adapted to output a signal representative of the waveform of the received pulses.

55. (currently amended) Apparatus according to Claim 53 ~~or 54~~, wherein the characteristic pulse frequency is between 2 MHz and 20 MHz, preferably between 5 MHz and 15 MHz, and more preferably between 10.5 MHz and 13.5 MHz.

56. (currently amended) Apparatus according to ~~any of Claims 53 to 55~~ Claim 53, wherein the detecting means comprises means for sampling the received pulse train and producing an output having a characteristic sampling frequency related to the characteristic pulse frequency.

57. (original) Apparatus according to Claim 56, wherein the sampling means comprises a downsampler, such that the output sampling frequency is lower than the characteristic pulse frequency.

58. (currently amended) Apparatus according to Claim 56 ~~or 57~~, wherein the output sampling frequency is between 5 kHz and 100 kHz, preferably between 25 kHz and 90 kHz, and more preferably between 60 kHz and 85 kHz.

59. (currently amended) Apparatus according to ~~any of Claims 56 to 58~~ Claim 56, further comprising an input sampling clock operating at substantially a given multiple of

the characteristic pulse frequency, an output sampling clock operating at the output sampling frequency, and wherein the sampling means is adapted to sample the signal on receipt of the input sampling clock signal and produce a sample output on receipt of the output sampling clock signal.

60. (original) Apparatus according to Claim 59, wherein the sampling means is adapted to produce the sample output as an average of the input samples taken since the previous output sampling clock signal.

61. (original) Apparatus according to Claim 60, wherein the sampling means is adapted to advance the phase of the input sampling clock by a predetermined amount after the sample output is produced.

62. (currently amended) Apparatus according to ~~any of claims 31 to 61~~ Claim 31, wherein the receiving means is adapted to receive at least one signal further to the signal transmitted by the incorporated transmitter, and the apparatus further comprises means for discriminating between the signal transmitted by the incorporated transmitter and the or each further signal.

63. (original) Apparatus for determining positional information relating to an object incorporating a transmitter, the apparatus comprising:

means for receiving a plurality of signals, each signal being transmitted by a respective one of a plurality of transmitters and said plurality of transmitters including the incorporated transmitter; and means for discriminating between a received signal transmitted by the incorporated transmitter and any further received signals, in dependence upon a characteristic, preferably a pulse repetition frequency, of the signal transmitted by the incorporated transmitter, said received signal transmitted by the incorporated transmitter comprising at least one ultra-wide band pulse.

64. (original) Apparatus according to Claim 63, wherein the signal transmitted by the incorporated transmitter is time-division multiplexed.

65. (currently amended) Apparatus according to Claim 63 ~~or 64~~, wherein the discriminating means comprises a detection clock operable to drive the detection of the signal transmitted by the incorporated transmitter, and means for setting the detection clock in dependence on a selected signal frequency, whereby signals having the selected signal frequency are preferentially detected by the apparatus.

66. (original) Apparatus according to Claim 65, further comprising means for detecting a frequency error between the selected signal frequency and the received signal, and means for compensating for the frequency error.

67. (original) Apparatus according to Claim 66, wherein the means for detecting a frequency error is adapted to estimate the signal frequency in dependence on the interval between successive peaks in the received signal corresponding to the peaks of successive pulses, and to compare the estimated signal frequency with the detection frequency.

68. (currently amended) Apparatus according to Claim 66 ~~or 67~~, wherein the means for detecting a frequency error is adapted to compute an estimated signal frequency in dependence on the phase difference of consecutive samples, and to compare the estimated signal frequency with the detection frequency.

69. (currently amended) Apparatus according to ~~any of Claims 66 to 68~~ Claim 66, wherein the means for compensating for the frequency error is adapted to create a matched filter prototype representing an expected signal shape as effected by the estimated frequency error.

70. (original) Apparatus for determining positional information relating to an object, comprising:

means for receiving a signal pulse, said signal pulse being an ultra-wide band signal pulse;

detecting means, coupled to the receiving means, for producing an output from which the angular position of the object can be determined; and

means for transmitting a probe signal towards the object;

wherein said receiving means and said transmitting means are arranged in a single housing or on a common substrate, and said signal pulse is one of a reflection of the probe signal from the object and a signal transmitted by a transmitter associated with the object.

71. (original) Apparatus according to Claim 70, wherein the means for transmitting a probe signal is adapted to transmit a different signal to the signal transmitted by the transmitter associated with the object.

72. (currently amended) Apparatus according to Claim 70 ~~or 71~~, further comprising means for encoding the probe signal, whereby it can be distinguished from the signal received from the object.

73. (currently amended) Apparatus according to ~~any of Claims 70 to 72~~ Claim 70, further comprising means for determining the positional information of an object irradiated by the probe signal.

74. (original) Apparatus according to Claim 73, further comprising means for comparing the positional information of the irradiated object to positional information relating to at least one known object, whereby anomalous objects can be identified.

75. (original) Apparatus according to Claim 74, further comprising means for generating an alert signal in dependence on the result of the comparison.

76. (currently amended) Apparatus according to Claim 74 ~~or 75~~, wherein the or each object includes the object with which the transmitter is associated.

77. (original) Apparatus for searching a detection volume for an object transmitting a signal, comprising:

an array comprising a plurality of receiving elements;

detecting means for detecting at least one signal from a given range gate arriving at the receiving elements and for generating an output signal representative of the at least one received signal; means for varying the range gate; and

processing means for determining the interval between the at least one signal being received at one of the plurality of receiving elements and the at least one signal being received at the or each of the other of the plurality of receiving elements, whereby the existence of the object and its angular position can be determined regardless of whether transmission of the signal from the object is synchronised with the apparatus.

78. (original) A method of determining positional information relating to an object incorporating a transmitter, the method comprising:

generating a signal pulse, preferably an ultra-wide band signal pulse;

transmitting the signal pulse from the incorporated transmitter to a receiving apparatus, said receiving apparatus being arranged in a single housing or on a common substrate and comprising a plurality of receiving elements;

detecting the relative timing of the signal pulse as received at the plurality of receiving elements; and producing an output from which the angular position of the object relative to the receiving apparatus can be determined.

79. (original) A method of determining positional information relating to an object incorporating a transmitter, the method comprising:

receiving a plurality of signals, each signal being transmitted by a respective one of a plurality of transmitters and said plurality of transmitters including the incorporated transmitter; and

discriminating between a received signal transmitted by the incorporated transmitter and any further received signals, in dependence upon a pulse repetition frequency of the signal transmitted by the incorporated transmitter, said received signal transmitted by the incorporated transmitter preferably comprising at least one ultra-wide band pulse.

80. (original) A method of determining positional information relating to an object, comprising:

receiving a signal at a receiving apparatus, said receiving apparatus comprising a plurality of receiving elements; and

applying a matched filter so as to detect an interval between receipt of the signal at one of the receiving elements and receipt of the signal at at least one other of the receiving elements, whereby to determine an angular position of the object.

81. (original) A method of determining positional information relating to an object, comprising:

arranging a receiving means and a transmitting means in a single housing or on a common substrate;

transmitting a probe signal towards the object using the transmitting means;

receiving a signal pulse with the receiving means, said signal pulse being one of a reflection of the probe signal from the object and a signal transmitted by a transmitter associated with the object, and said signal pulse preferably being an ultra-wide band signal pulse; and

producing an output in dependence upon the received signal pulse from which the angular position of the object can be determined.

82. (original) A method of searching a detection volume for an object transmitting a signal, comprising the steps of:

setting a range gate;

detecting at least one signal, if such at least one signal has been received at an apparatus comprising a plurality of receiving elements;

determining the interval between the at least one signal being received at one of the plurality of receiving elements and the at least one signal being received at the or each of the other of the plurality of receiving elements;

varying the range gate; and

repeating the detecting and determining steps, whereby the existence of the object and its angular position can be determined regardless of whether transmission of the signal from the object is synchronised with the apparatus.

83. (currently amended) A signal suitable for use with apparatus or methods according to ~~any preceding claim~~ Claim 1.

84. (original) A signal comprising a pulse train having a characteristic frequency, wherein the characteristic pulse frequency is between 2 MHz and 20 MHz, preferably between 5 MHz and 15 MHz, and more preferably between 10.5 and 13.5 MHz, and the pulses have a characteristic frequency of between 0.5 GHz and 24 GHz, preferably between 2 GHz and 12GHz, and more preferably between 5.8 GHz and 7.2 GHz.

85. (currently amended) A signal according to Claim 83 ~~or Claim 84~~ encoded using time-division multiplexing.

86. (currently amended) A signal according to ~~any of claims 83 to 85~~ Claim 83, encoded using pulse-position modulation.

87. (currently amended) A computer program product adapted to perform a method as claimed in Claim 30 ~~or any of claims 78 to 82~~.

88. (original) A computer readable medium tangibly embodying a computer program product according to Claim 87.

89. (original) A signal tangibly embodying a computer program product according to Claim 87.